B1

PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : F24F 12/00 | A1

(11) International Publication Number: **WO 97/35152**

(43) International Publication Date: 25 September 1997 (25.09.97)

(21) International Application Number: PCT/NO97/00054

(22) International Filing Date: 20 February 1997 (20.02.97)

(30) Priority Data:
9601055-8 20 March 1996 (20.03.96) SE

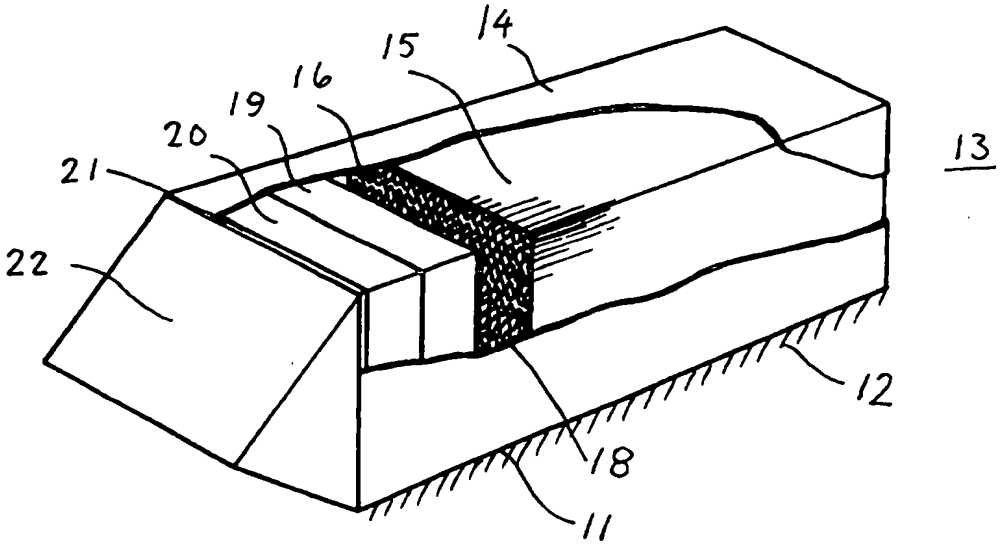
(71)(72) Applicant and Inventor: NORMANN, Erling, C. [NO/NO]; Björketun 6, N-7650 Verdal (NO).

(74) Agent: CURO A/S; P.O. Box 38, N-7094 Lundamo (NO).

(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, US, UZ, VN, ARIPO patent (KE, LS, MW, SD, SZ, UG), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

Published
With international search report.
With amended claims.
In English translation (filed in Norwegian).

(54) Title: VENTILATION DEVICE AND WINDOW FOR ACCOMMODATING THE SAME



(57) Abstract

Ventilation device, with a heat exchanger element (15) for interchangeable blowing of air to and from a room, such as a living room or office room, in which the heat exchanger element is rod- or dish shaped with penetrating passages. At least one fan (19, 20) adjoining the heat exchanger element (15), which can be controlled for interchangeable outlet and inlet of air from and to the room, communicating through a wall separating the room from the ambient air. A control circuit being provided for operating the fan or fans interchangeably. The heat exchanger element (15) is tightly received in a ventilation device housing (14) which is provided with an access opening facing the room and which may be opened for inserting and removing of the heat exchanger element. The ventilation device housing (14) is provided for accommodation generally in an opening in a wall, to hold major parts of the ventilation device in the wall. At least one fan (19, 20) is provided at the side of the wall, which is facing the ambient air.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece			TR	Turkey
BG	Bulgaria	HU	Hungary	ML	Mali	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MN	Mongolia	UA	Ukraine
BR	Brazil	IL	Israel	MR	Mauritania	UG	Uganda
BY	Belarus	IS	Iceland	MW	Malawi	US	United States of America
CA	Canada	IT	Italy	MX	Mexico	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NE	Niger	VN	Viet Nam
CG	Congo	KE	Kenya	NL	Netherlands	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NO	Norway	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	NZ	New Zealand		
CM	Cameroon			PL	Poland		
CN	China	KR	Republic of Korea	PT	Portugal		
CU	Cuba	KZ	Kazakstan	RO	Romania		
CZ	Czech Republic	LC	Saint Lucia	RU	Russian Federation		
DE	Germany	LI	Liechtenstein	SD	Sudan		
DK	Denmark	LK	Sri Lanka	SE	Sweden		
EE	Estonia	LR	Liberia	SG	Singapore		

VENTILATION DEVICE AND WINDOW FOR ACCOMODATING THE SAME

The invention relates to a ventilation device as stated in the introductory part of claim 1 and a window for mounting of such a ventilation device.

Background

The requirements for energy saving and the need for better ventilation has created a need for ventilation devices which can save energy by preserving warm air within a room, need little space and have low power consumption.

It is known to provide buildings, such as homes, apartments, office buildings, schools and similar with regenerative heat exchangers which are comprised of a central unit which supplies and removes air from the different rooms of the building through ducts arranged in the walls and/or ceilings. This requires a large amount of equipment and labourintensive installation. both being costly. Additionally, this solution is difficult to implement in existing buildings.

Ventilation devices are also known for installation into walls, which comply to some of the requirements for practical use. For example it is known to arrange a fan in an opening in a wall and place adjacent thereto a heat exchanger element. Existing equipment of this type has, however, been expensive, energy consuming and has a high noise level.

It is further known to arrange two equal and symmetrically operating ventilation devices in a tandem mode, to achieve balance between inlet and outlet air. Such prior art tandem ventilation devices hava been to large and expensive for privat dwellings.

Object

The main object of the invention is to provide a ventilation device which makes it possible to provide several rooms of a building, e.g. each or a substantial part of the rooms of a family house, with a heat exchanger. A heat exchanger is desired, which can be accomodated in an opening in a wall or a window, without further elements, except for covers, extending over the wall surface.

Further, a ventilation device is desired, with a low noise level, to avoid creating undesirable noise in the room in which the ventilation device is located.

A further important object is to provide a ventilation device which is simple to maintain, so that a large number of ventilation devices in a bulding may easily be cleaned for dust and other contamination.

It is also an object to provide a ventilation device which can be manufactured with small dimensions with the aim of locating it in a window frame. Additonally, it is an object to provide a ventilation device which can use a low power axial or radial fan.

A particular object is to decrease the power consumption to a level allowing operation with a solar panel powered battery.

In cases with the need for particular economy of energy, balanced air exchanges is desirable, i.e. letting in and taking out the same amount of air.

For some purposes, a ventilation device cooling the inlet air is required.

The invention

The main object of the invention is achieved by designing the ventilation device as stated in claim 1.

With this device, the main operating requirements, of low power consumption and small dimensions, are achieved. Additionally there is a great simplification and saving in mounting work compared to known equipment having one central unit.

It is possible to manufacture the ventilation device to fit into existing ventilation openings in a wall or in a slot with the height of appr.10 cm in a window frame. It is also possible to power the ventilation device by a small solar panel arranged outside the wall in conjunction with a cover. It is possible to provide the ventilation device with a water supply through nozzles, which will cool inlet hot air through the ventilation device.

A control system is provided with sensors registering the inside and outside temperatures, level of humidity and/or existence of odors in the room to be ventilated.

Different features of the invention are stated in claims 2-9. In claim 10 a window for mounting a ventilation device according to the invention, is described.

More details of the invention are given by the description of following examples.

Examples

Below, the invention is further described with reference to the accompanying drawings, in which:

Fig. 1 shows a partial section perspective view of an embodiment of the invention, in which a ventilation device for arrangement in the opening of a wall is provided with two fans arranged adjacently,

Fig. 2 shows a section through the ventilation device of Fig. 1,

Fig. 3 shows a schematical perspective view of a ventilation device provided for installation in a slot in a window.

Fig. 4 shows an exploded view of an embodiment supplying a water fog,

Fig. 5 shows an embodiment with a double set of heat exchangers to provide balanced air exchange,

Fig. 6 shows an embodiment with the ventilation device at the top of a window,

Fig. 7 shows an embodiment with the ventilation device arranged at the side of a window, while

Fig. 8 shows a further embodiment of the ventilation device, which can be arranged at the side of a window.

Fig. 1 and 2 illustrates a ventilation device according to the invention provided for mounting in a cylindrical opening 11 in a wall facing the atmosphere, e.g. of a living room 13. The ventilation device comprises a tubular housing 14 of steel plates or plastic, with a square or substantially square cross section. In a modified embodiment, the section can be cylindrical. At the end of the housing 14 facing into the room 13, a heat exchanger 15 occupies the cross section of the housing 14 toward the outer end thereof, within a certain distance of the end. The heat exchanger 15 can be manufactured in several known ways. For example it can be manufactured of corrugated aluminium sheets 16 which are covered by a tubular sheeting 17. The sheating, which may also be of aluminium, is fitted within the housing 14 to be removable inserted into this. Thus the heat exchanger 15 may easily be extracted for cleaning. With suitable design of the inner cover of the housing (not shown), this may be conducted by a normal consumer, the heat exchanger being placed in a dish washer for cleaning.

In a free space 18, between the heat exchanger 15 and the outer end of the housing 14, two low power axial fans are mounted, an inner fan 19 and an outer fan 20. The fans may be rated for a power consumption of 5-20 watts. The fans may be partioned by a flow guide which may comprise a honeycomb-sheet, e.g. of plastic, with a thickness of 5-10 mm, which reduces turbulence at the starting and stopping of the fans. By arranging the fans 19 and 20 in series and operating them interchangably, equal movement of air in both directions can be achieved. When operated at equal intervals, the same amount of air is let in and out.

Arrangement of the two fans at the same end of the housing 14 allows for an easy removal of the heat exchanger 15. This is important for the maintenance, as it enables unskilled personel to maintain, particularly by cleaning, the equipment.

It is also possible to use only one fan and change at intervals the direction of rotation. This will save space and equipment costs, but reduce effective time of operation, because of the stopping time for the rotor of the motor and the fan blades at each change of direction.

To increase the efficieny of the exchange of heat, two fans can be arranged adjacently, or with a certain distance in the same room for tandem operation. With interchanging operation, a complete balance in the interchange of air is achievable. It means that all air let into a room will stay in the room, and all air let out of a room originates from that room. Thus loss of warm air from the room is avoided. Also the intake of cold air from the outside, cannot bypass the heat exchanger. In addition to this, air from one room, e.g. a kitchen, is not passed to neighbouring rooms, thereby avoiding transfer of odors from one room to another.

For the interchanging operation of the two fans of fig. 1 and of a further ventilation device in the case of tandem operation, a prior art electronic control unit is used to control the length of intervals. The length of intervals will depend on the capacity of the heat exchanger, the fan capacity and the temperature difference. It is also possible to provide such a control unit to be started by a temperature and/or odor/moisture sensor, e.g. in connection with use in a bath or toilet.

At the outer end of the ventilation device, a filter 21 to stop insects and dust is provided. Such a filter can be extended to stop pollen and other micro particles.

Over the filter at the outer end of the ventilation device, a half roof shaped cover 22 is arranged to protect the filter against rain and other impact, such as ball throwing.

In an alternative embodiment, the cover 22 can be covered by solar cells to collect energy for the operation of the fan motors. Such solar cells should be combined with a battery, which can be arranged at the adjoining end of the housing 14. The ventilation device can thus be a self powered unit, without need for connection to a power supply for the operation of the fans or for powering the control unit.

Fig. 3 illustrates a ventilation device 23 for arrangement in or at a window is shown, e.g. at the upper edge of a window frame (see Fig.6). The ventilation device 23 has a box shaped housing 24 with openings and active elements as described below. The housing has a height which is substantially less than the width, which again is substantially less than the length. The housing 24 is divided approximately in the middel into an upper and a lower part. Centrally in the upper part of the housing, a heat exchanger 25 with a design corresponding to the design of the heat exchangers of the example above, except for a low height and a width corresponding to the width of the window frame, is provided. The housing 24 has an opening 26 facing the room, which is covered by lid 27, which may be fastened with two screws (not shown). Through the opening 26 the heat exchanger element can be removed and reinserted without particular skill or tools. At the ends of the heat exchanger element 25 air chambers 28, 29 are present in the upper part of the housing 24, which are connected to two fans 30 and 31, respectively. The fans 30 and 31 are horizonally disposed radial fans which have a central opening towards the air chambers 28, 29 and a lateral opening towards a common, interposed central air chamber 32.

The central air chamber 32 has an opening 33 towards the room and an opening 34 facing the external wall, a diagonally extending partition wall 35 then divides the air flows from the fans 30 and 31. Thus a flow path is defined from the room to the ambient air through the fans, the heat exchanger and the different air chambers.

In operation, the fans 30 and 31 are powered interchangebly in intervals, to let air in and out. Thus the ventilation device can be controlled in a continous operation, without a time lag for stopping the fans. This will increase the heat exchange. By using two such ventilation devices in a unit in the same room the energy exchange can be increased further, as all the air passing to and from the room is passing through a heat exchanger.

The embodiment of Fig. 3 can be modified in various ways. Each of the fans 30 and 31 can be replacded by more smaller fans which can be arranged in parallel. The fans 30 and 31

can also be arranged directly against the heat exchanger 25, at the same level. An air chamber for each fan 30 and 31 is then needed on a different level, to conduct air to and from the room.

In Fig. 4 is shown an exploded perspective view of an embodiment with a substantially square tubular housing 41. In the housing 41, two fans are arranged at one end, an inner fan 42 and an outer fan 43, back to back, i.e. blowing air towards each other. Between the fans 42 and 43, a flow guide 44 with a honeycomb cell structure is arranged as in the embodiment of Fig. 1. On the inner side of the inner fan 42 a heat exchanger element 46 is arranged, on the other side of which is a chamber 50. At the upper part of the chamber 50, facing a filter 47 on the inner wall of the housing, is a manifold 48, with at least one, but preferably a pluratlity of nozzles, is arranged. The manifold is connected to a water supply under pressure over a valve (not shown) which can be automatically switched by an electronic control circuit. The heat exchanger element 46 is adapted for insertion and removal from the housing 41 by a correspondingly simple method as described for the embodiments above, after removal of the filter 47.

The housing 41 can be arranged in an opening in a wall, or within or at window frame, e.g. as an integrated part of a window, on the inner side of a wall, with or without connection to a ventilation system. A filter 49 is shown at the outer opening.

At the outlet of room air, water is supplied to the chamber 46 by opening the water valve during the outlet interval. Water mist will be deposited on the faces of the heat exchanger element, will evaporate, and cool the element. When hot ambient air in the next interval is let in with the water valve closed, it will be cooled by the heat exchanger and enters the room at the inner side of the wall with a lower temperature than the ambient temperature.

As an alternative to the use of water jets from nozzles, the evaporating of water can be achieved in other ways, e.g. with electrostatical plates.

In Fig. 5 a double version of a ventilation device according to the invention is shown. The device 51 is suited for arrangement at a window, corresponding to the device of Fig. 3, but can also be arranged on a wall. It comprises two heat exchanger elements, an upper 52 and a lower 53, which both are centrally arranged and designed for insertion and removal from one side, preferably facing the room. The upper heat exchanger element 52 has at ist one end an upper fan 54 with a central opening facing a lower air chamber 55 with an opening 56

toward the outer side of the wall. The lower heat exchanger element 53 has correspondingly a lower fan 57 with an opening towards an upper air chamber 58 with an opening to the room.

The lower air chamber 55 is provided with a diagonal wall 60 which partitions this air chamber into an outer part connecting to the fan 54 and an inner part connecting the lower heat exchanger element 53 with the room over an inner opening 61. Correspondingly the upper air chamber 58 is provided with a diagonal partition 62 which divides this chamber and provides an outer part which connects the upper heat exchanger element 52 with the outer side of the wall.

In this embodiment, the fans 54 and 57 are operated interchangeably for pressure and suction. This will create a certain difference in air movement, but this loss will be compensated by a continous inlet and outlet of air in parallel operation. Thus substantial air leakage bypassing the heat exchanger is avoided. In this way, a particularly efficient energy regeneration is achieved. If this is to be further improved, each flow of air may have a double set of fans, to achieve complete balance of air exchange.

In Fig.6, a vertical section through a window is shown, with a window fram 63, in the following called the upper frame, with an extension 64. Over the upper frame 63 and the extension 64, a ventilation housing 65 corresponding to that of Fig. 3 is arranged. The ventilation housing 65, it is covered by a top frame 66 which has the total width of the upper frame 63 and the extension 64. The outer and inner side the housing is covered by a lid 67, 68 with covers 69 and 70. The covers 69, 70 are provided with slits for air communication.

The top frame 66 extends over the width of the window and provides a chamber 71. In narrow windows, the housing 65 may occupy this chamber completely, while it at windows with a large width, e.g. 80 cm, there may be a space left at both ends, which can be filled with insulation material (not shown). The height of the housing 65 and the top frame 66 will conform to the module system of windows, e.g. with outer measures adapted to 10-cm modules.

The inner structure and the function of the heat exchanger element and fans for the housing 65 may correspond with that of Fig. 3 and 5.

In Fig. 7 is shown a vertical section through a ventilator intended for use at the side of a window. The ventilation device of the example has a chimney like ventilation device box 72

which is covered on its inner side by thermal insulation elements 73, e.g. of mineral wool. The upper end of the box 72 is closed and provided with a sideward outlet 74 facing the inner side of the wall and covered by a perforated cover 75. Under the top of the box 72 a space 76 is provided for a control unit for the fans as described below.

The lower end of the box 72 has a sideward outlet 77 facing the outer side of the wall and is provided with a lower fan 78 with an integrated motor. In the lower part of the box 72, a heat exchanger element 79 is arranged and above this there is an upper fan 80 equal to the lower fan. The upper part of the box 72 above the fan 80 is covered with insulation sheets 81, primarily for noise reduction. On the outer side of the wall the box 72 is covered by a lamell structure 82, partly for air inlet, partly for creating a unitary appearance.

This ventilation device can be arranged in air channels in existing windows or within new buildings where a sideward arrangement of the ventilation device is preferred. On interchanging operation of the fans 78 and 80, similar advantages as for the ventilation devices above will be achieved. In this embodiment, the ventilation device box 72 can easily be removed from the opening in the wall to give access to the heat exchanger element 79, for removal for cleaning.

In Fig. 8 is shown a ventilation device with a tubular housing 83 with a circular or rectangular section, intended for arrangement with a vertical axis. In the central part of the housing a heat exchanger element 84 is arranged similar to the embodiment of Fig. 7, and occupies a section of the housing. Thus the heat exchanger 84 is removable sidewardly through an opening with a cover 85 for cleaning. At the upper end the housing 83 has a sideward conduit 86 with opening to a room 87. In the conduit 86 a fan 88 for blowing air from the outer side of the wall is arranged. Correspondingly, a lower conduit 89 directed opposite to the upper conduit, is arranged at the lower end of the housing, facing the ambient air 90. In the lower conduit 89 a fan 91 for blowing air from the room 87 is arranged. The fans 88 and 91 are controlled interchangably as described above by a control circuit (not shown).

At the upper end of the housing 82 a water supply 93 is connected to a manifold 94 with nozzles for inlet of water as described in connection with Fig. 4. The housing 82 has a drainage valve 92 for removal of excessive water.

The housing 83 can be mounted in a wall or otherwise close to the room 87.

Claims:

1. Ventilation device, with a heat exchanger element (15) for interchangably blowing of air to and from a room, such as a living room or an office room, in which the heat exchanger element is rod- or dish shaped with penetrating passages, at least one fan (19, 20) adjoining the heat exchanger element (15), which fan or fans can be controlled for interchangable outlet and inlet of air from and to the room, communicating through a wall or a room divider separating the room from the ambient air, a control circuit being provided for operating the fan or fans interchangably,

characterized in that

- the heat exchanger element (15) is thightly received in a ventilation device housing (14) which is provided with an access opening facing the room and which may be accessed for insertion and removal of the heat exchanger element,

- the ventilation device housing (14) is provided for accomodation generally in an opening in a room divider, particularly in a wall or a window frame, to hold major parts of the ventilation device in the opening, and

- at least one fan (19, 20) is provided at the side of the wall which is facing the ambient air.

2. Ventilation device according to claim 1,

characterized in that the fan or fans (19, 20) are provided with low power motors.

3. Ventilation device according to claim 1 or 2, with two fans,

characterized in that the fans (19, 20) are arranged adjoiningly.

4. Ventilation device according to claim 3,

characterized in that the ventilation device housing (24) is provided for arrangement at the top of a window, with rod shape in the sideward extension of the window, and that the fans (30, 31) are radial fans arranged with vertical axis at each end of the ventilation housing with communication through a dish shaped heat exchanger element (35) arranged in the middle of the housing.

5. Ventilation device according to claim 1,
characterized in that the the housing is provided for arrangment at the top of a window with rod shape in the sideward direction of the window, that is has two groups of fans (54, 57), and that heat exchanger elements are arranged in a stack, with independent air flow, to achieve balanced air exchange.

6. Ventilation device according to claim 1,
characterized in that the fans (42, 43) are enclosing an air flow guide (44) with series of air passages, particularly a dish shaped element with honeycomb structure or a heat exchanger element.

7. Ventilation device according to claim 1 or 6,
characterized in that adjoining the heat exchanger element (47) on the inner side thereof, a manifold (45) with one of more nozzles is arranged, for intermittent atomizing of water at the outlet of air from the room.

8. Ventilation device according to one of the claoms 3-7,
characterized in that the outside of the partition is provided with an inclined cover (22) which carries solar cells provided to power the fans.

9. Ventilation device according to claim 2,
characterized in that the housing (83) is tubular with a vertical axis and with a manifold (94) at the upper end for atomizing water, the housing being provided with tubular connectors (86, 89) enclosing fans (88, 91) and with a cover (85) providing access for inserting and removal of a heat exchanger (84).

10. Window for accomodating a ventilation device according to one of the claims 4 or 5, **characterized** in that a chamber (71) is arranged at the upper edge of the window, with a cover element (66) providing the upper window frame, said chamber being provided with an opening at least towards the inner side of the window, for inserting and removing of the ventilation device (65).

AMENDED CLAIMS

[received by the International Bureau on 29 August 1997 (29.08.97); original claims 1-10 replaced by amended claims 1-5 (2 pages)]

1. Ventilation device, with a heat exchanger element (15) for interchangably blowing of air to and from a room, such as a living room or an office room, in which the heat exchanger element is rod- or dish shaped with penetrating passages, at least one fan (19, 20) adjoining the heat exchanger element (15), which fan or fans can be controlled for interchangable outlet and inlet of air from and to the room, communicating through a wall or a room divider separating the room from the ambient air, a control circuit being provided for operating the fan or fans interchangably, where a ventilation device housing (14) receiving the heat exchanger element (15) is provided for accomodation generally in an opening in a room divider, particularly in a wall or a window frame, to hold major parts of the ventilation device in the opening,

characterized in that

- the heat exchanger element (15) is thightly received in a ventilation device housing (14) which is provided with an access opening facing the room and which may be accessed for insertion and removal of the heat exchanger element,

- at least one fan (19, 20) is provided at the side of the wall which is facing the ambient air, and that the ventilation device housing (24) is provided for arrangement at the top of a window, with rod shape in the sideward extension of the window, and that the fan or fans (30, 31) are radial fans arranged with vertical axis at each end of the ventilation housing with communication through a dish shaped heat exchanger element (35) arranged in the middle of the housing.

2. Ventilation device according to claim 1,

characterized in that it has two groups of fans (54, 57), and that heat exchanger elements are arranged in a stack, with independent air flow, to achieve balanced air exchange.

3. Ventilation device according to claim 1, with two fans,

characterized in that the fans (42, 43) are enclosing an air flow guide (44) with series of air passages, particularly a dish shaped element with honeycomb structure or a heat exchanger element.

4. Ventilation device according to claim 1, **characterized** in that adjoining the heat exchanger element (47) on the inner side thereof, a manifold (45) with one of more nozzles is arranged, for intermittent atomizing of water at the outlet of air from the room.

5. Window for accomodating a ventilation device according to one of the claims 1 or 2, **characterized** in that a chamber (71) is arranged at the upper edge of the window, with a cover element (66) providing the upper window frame, said chamber being provided with an opening at least towards the inner side of the window, for inserting and removing of the ventilation device (65).

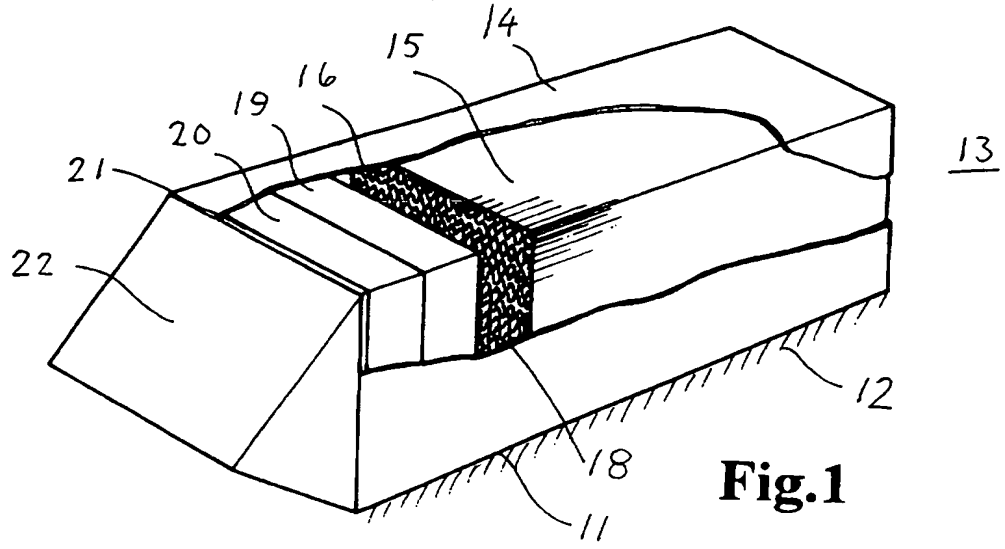


Fig.1

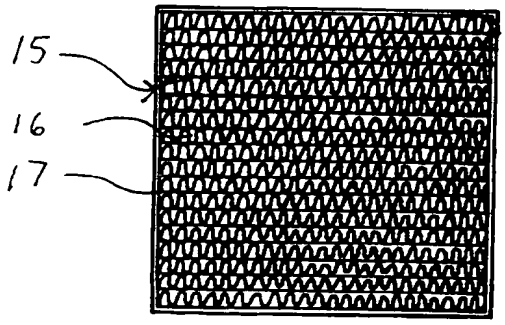


Fig.2

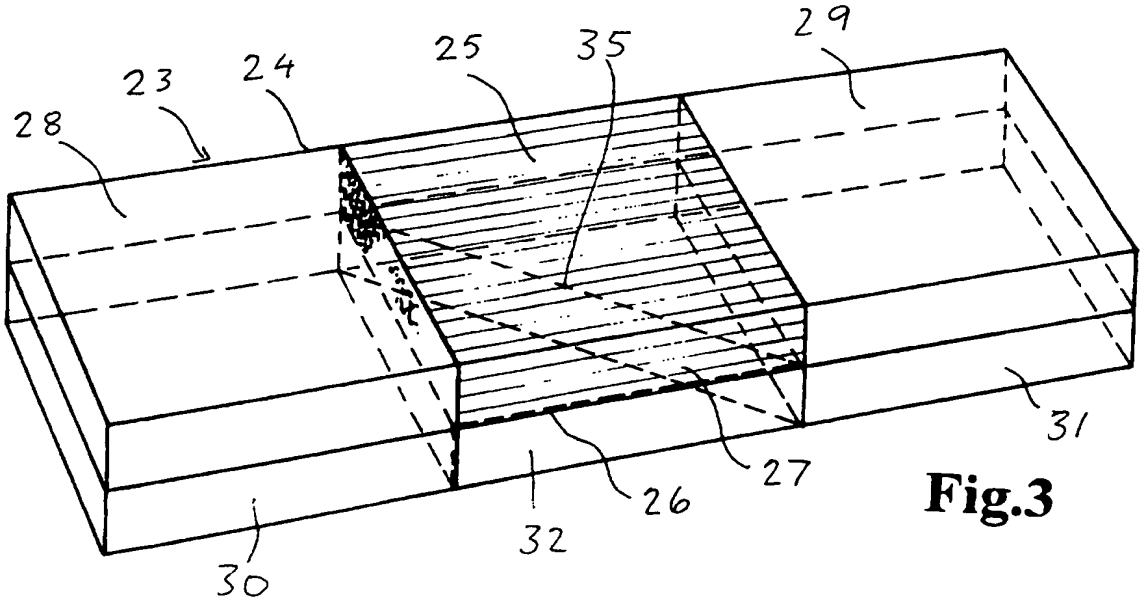


Fig.3

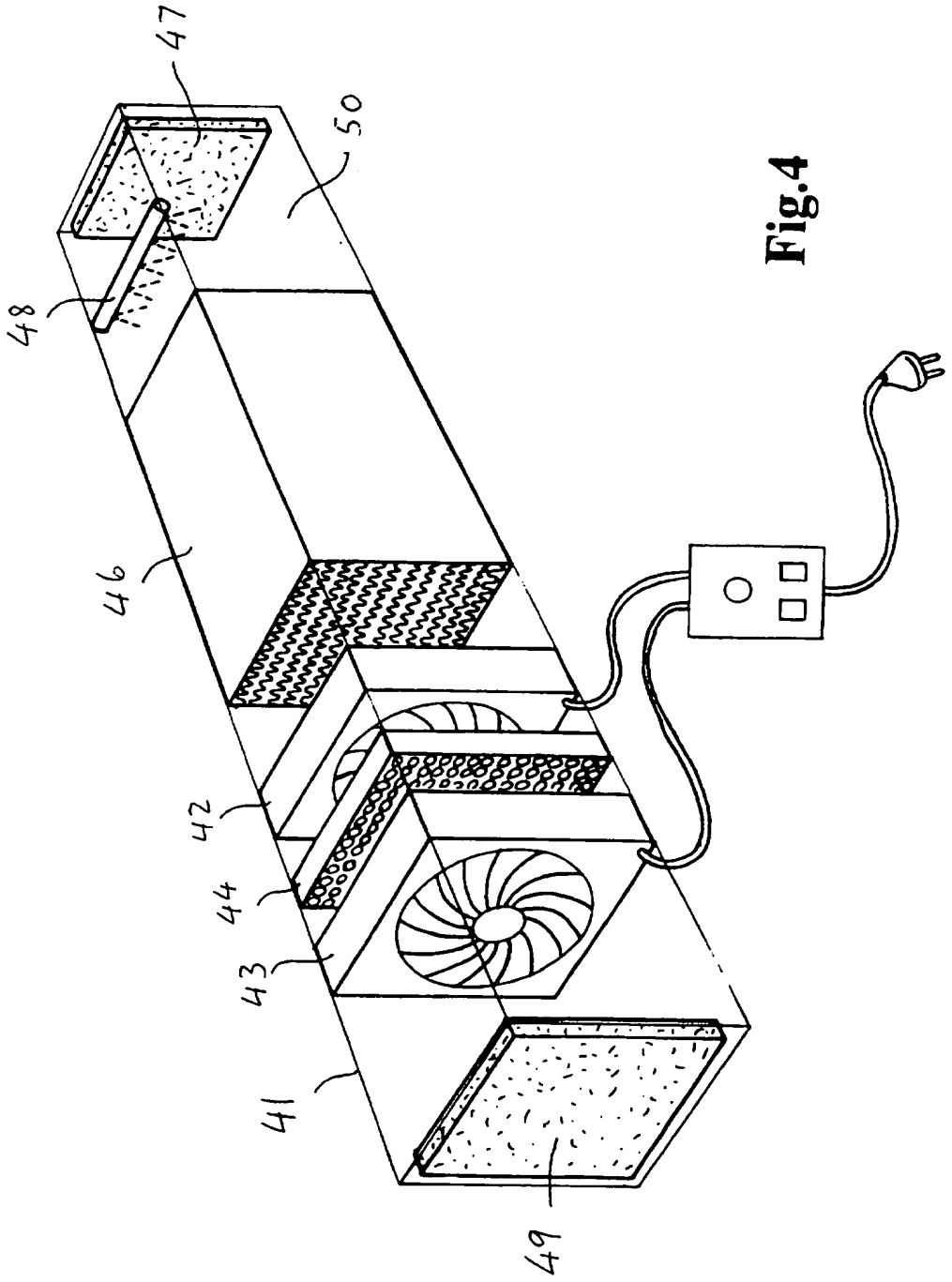


Fig.4

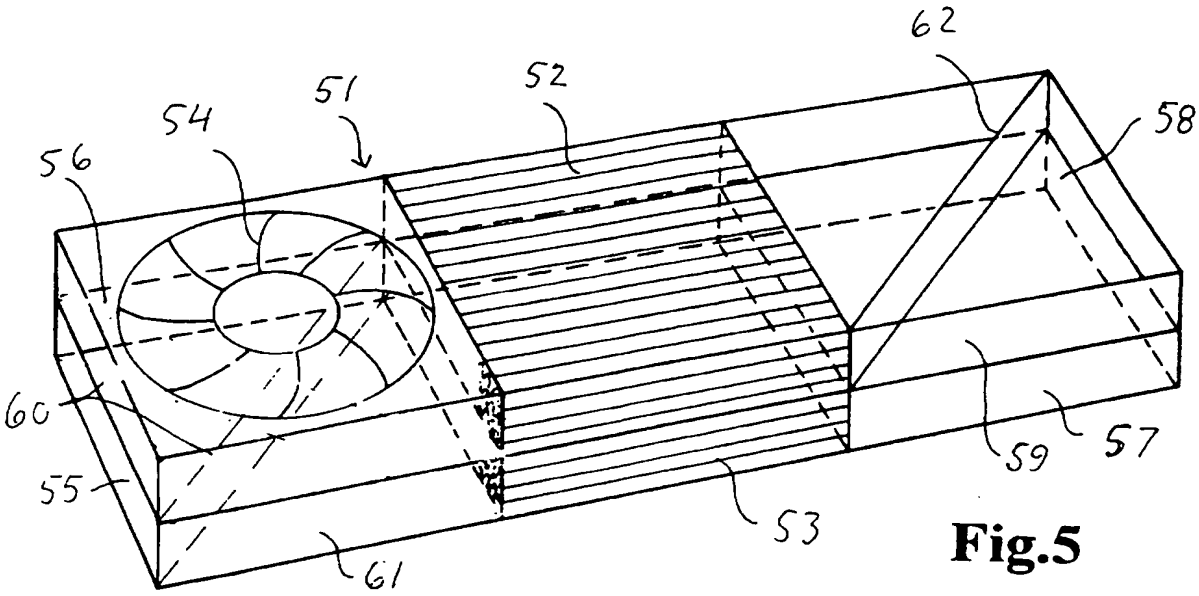


Fig.5

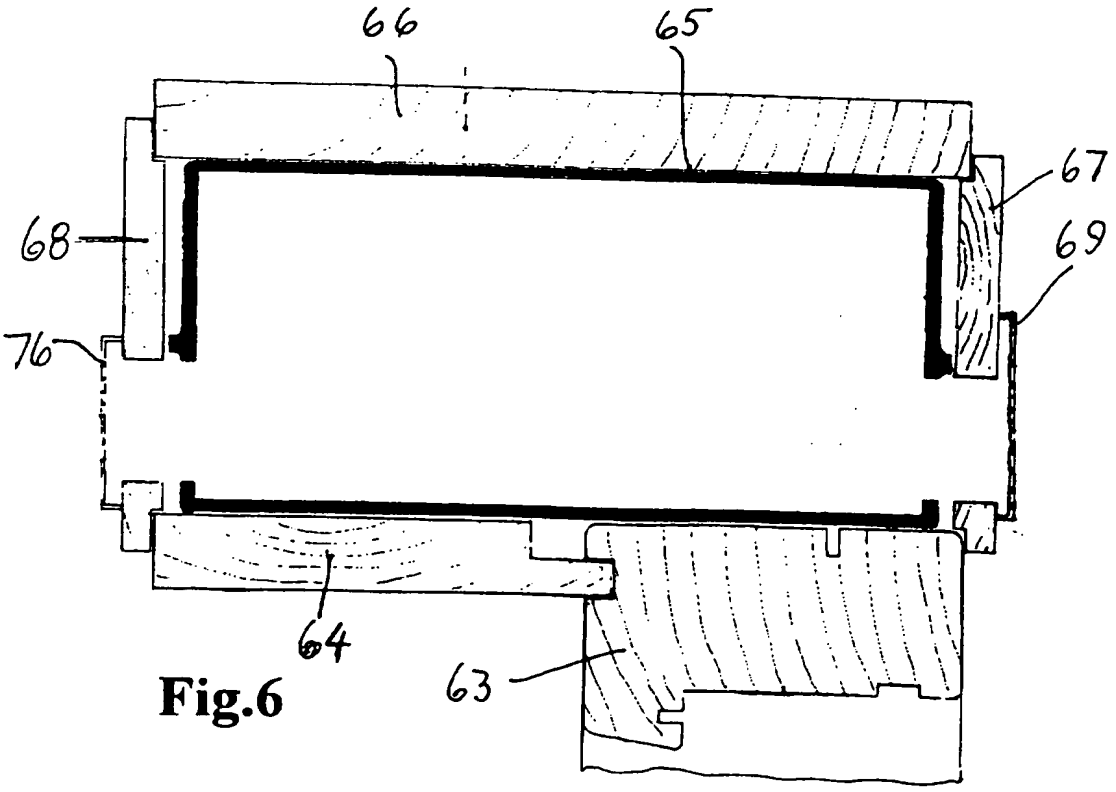


Fig.6

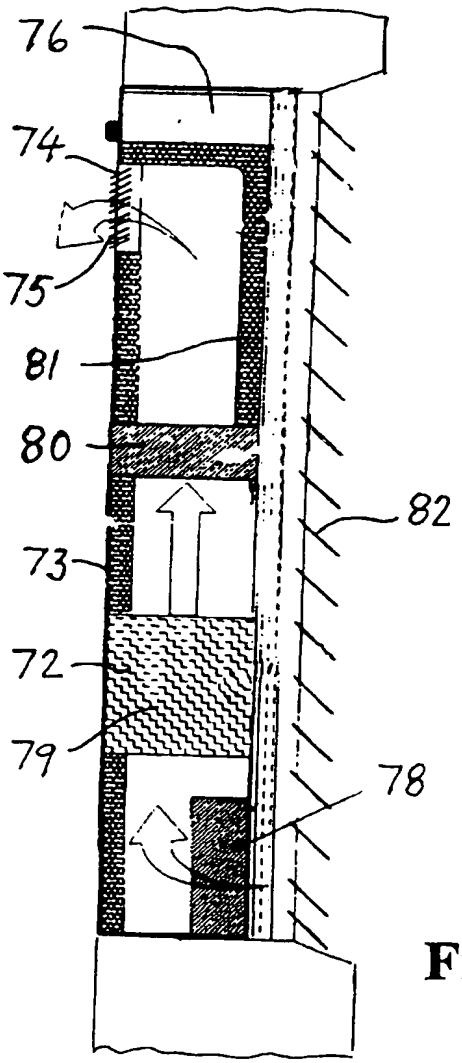


Fig.7

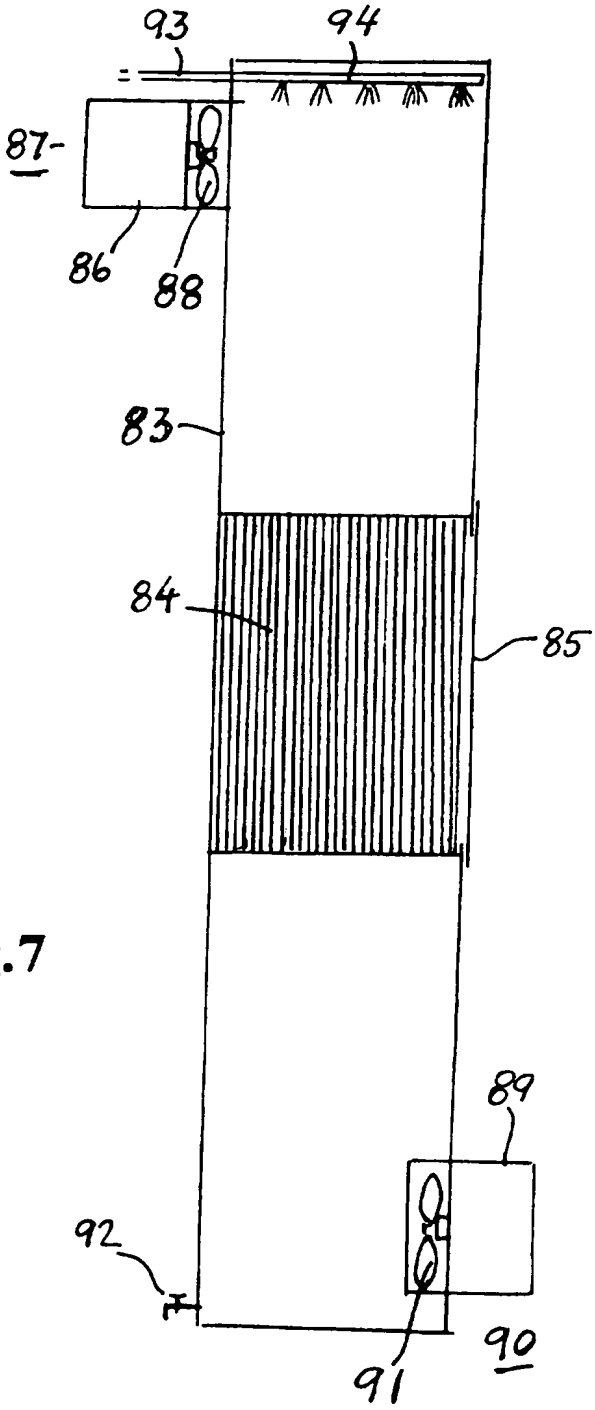


Fig.8

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NO 97/00054

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: F24F 12/00
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: F24F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 4104423 A1 (KLAWITTER, ERICH), 20 August 1992 (20.08.92) --	1
X	EP 0438037 A1 (BERGMAN, KURT TAGE LENNART), 24 July 1991 (24.07.91)	1,3,4,6
Y		2,5
	--	
Y	WO 9514890 A1 (NORMANN, ERLING, C.), 1 June 1995 (01.06.95) --	1,2,3,5
Y	WO 9418507 A1 (HALLBERG, JÖRGEN), 18 August 1994 (18.08.94) --	1,3,5

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" erlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
11 August 1997	19.08.97
Name and mailing address of the ISA Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Helene Eliasson Telephone No. +46 8 782 25 00

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NO 97/00054

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 9408182 A1 (COHAUSZ, HELGE, B), 14 April 1994 (14.04.94)	1,2
	--	
Y	DE 3613942 A1 (KLAWITTER, ERICH), 29 October 1987 (29.10.87)	1,2
	--	
Y	GB 2141819 A (OY NOKIA AB), 3 January 1985 (03.01.85)	1
	--	

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NO 97/00054

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see extra sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

1) Claims 1-6 refer to a ventilator with regenerative heat transfer elements

2) Claim 7 refers to a ventilator including water nozzles

3) Claim 8 refers to ventilator fans powered by solar energy

4) Claim 9 refers to a ventilator casing and water supply at its upper part

(lack of unity à posterior)

INTERNATIONAL SEARCH REPORT

Information on patent family members

06/08/97

International application No.
PCT/NO 97/00054

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 4104423 A1	20/08/92	NONE	
EP 0438037 A1	24/07/91	DE 69007772 D,T	28/07/94
WO 9514890 A1	01/06/95	AU 1204695 A	13/06/95
		NO 934307 A	30/05/95
WO 9418507 A1	18/08/94	DE 69311717 D	00/00/00
		EP 0638013 A,B	15/02/95
		FI 945096 A	28/10/94
		JP 7506058 T	06/07/95
		SE 9300382 A	06/08/94
		SE 9403706 A	28/10/94
		US 5445232 A	29/08/95
WO 9408182 A1	14/04/94	DE 4233529 A	07/04/94
DE 3613942 A1	29/10/87	NONE	
GB 2141819 A	03/01/85	CA 1264598 A	23/01/90
		DE 3420295 A	06/12/84
		DK 272284 D	00/00/00
		FR 2547023 A,B	07/12/84
		SE 8402931 A	04/12/84